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Decoding the 'Artificial' Epoch: “Embracing Speculative Architectural-Design Methodologies in the era of AI by addressing the Computational Continuum”

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Abstract

In the contemporary epoch marked by paradigm shifts, as articulated by Saggio in "The IT Revolution in Architecture" (Saggio, 2013), our world is enmeshed in a tapestry of evolving architectural ideologies. The current correlative relationship between those, are blurred superimpositions of influential waves which define a multi-dimensional complexity which resembles a simplified fragrance of the quantum state. The integration of AI into architecture marks a seismic shift, challenging the very narrative that has historically defined architectural discourse. As AI methodologies continue to unfold, they introduce a paradoxical dynamic, redefining conventional perspectives and prompting a reexamination of architectural legacies. The roots of speculative design, deeply embedded in avant-garde movements of yore, now intersect intriguingly with the emergence of AI. Speculation, an inherent aspect of architectural exploration, discovers resonance in the iterative and generative capacities of AI methodologies. These technologies, acting as speculative agents themselves, transcend conventional design constraints, engendering a novel dialogue between human creativity and computational ingenuity. This unfolding narrative opens up new dimensions within the ever-evolving saga of architectural expression by reading and defining this dynamic tension, simultaneously challenging and aligning with tradition, propelling the discipline into unexplored territories that also embrace individualities. Within this metamorphic landscape, this research will try to articulate the correlation of generative design thinking in approaching AI generative methodologies in addressing new architectural design processes; precipitated as an emergence in the ever-evolving Architecture, Engineering, and Construction (AEC) industry. This study lays a foundation for understanding AI's role in architecture but also points to significant areas for further inquiry.

Keywords

Artificial intelligence, neural networks, space-time, architectural design, parametricism

Historical context of computation and architecture

The genesis of computational power's integration in architecture can be traced back to the cybernetic theories of the mid-20th century. Gordon Pask's work, particularly in "The Architectural Relevance of Cybernetics", not only introduced the idea of responsive environments but also hinted at a future symbiosis between human cognition and computational processes in design (Pask, 1969, pp. 494-496). This notion was revolutionary, laying a philosophical foundation for future AI integration. In the 1970s and 1980s, the concept of computational design began to materialize beyond theoretical frameworks. Christopher Alexander's "The timeless way of building" was pivotal in this regard, advocating for a design methodology that is both responsive and adaptive to human needs and environmental contexts, prefigures a speculative framework where AI tools are not merely instruments but partners in creating spaces that embody the complexity and richness of life (Alexander, 1979, pp. 117-122). Integrating Alexander's principles, this period can be seen as a nascent stage in the quest for a more humane and ecologically integrated approach to architectural design, facilitated by the collaboration between human intuition and computational capabilities. The late 20th century saw further advancements with John Frazer's "An Evolutionary Architecture" (Frazer, 1995), emphasizing architecture that adapts and evolves, akin to natural organisms. This work foresaw the adaptive capabilities, aligning closely with today's generative design methodologies (Frazer, 1995, pp. 110-125). The current state of AI in architecture is a culmination of many other historical developments, characterized by an intricate blend of creativity and computational intelligence. This blend echoes in the works of contemporary theorists like Mario Carpo in "The Second Digital Turn" (Carpo, 2017), where he discusses the democratization of design through digital tools, an ethos central to AI's role in architecture today (Carpo, 2017, pp. 20-35). Figure 1 shows a more detailed and comprehensive visual diagram of the historical prevalence of computation in architecture, mapped and published in 2023 by Mark Garcia and Steven Hutt, based on Carpo's sequential researches as well as other sources (Fig. 1). The future trajectory of AI in architecture, while unpredictable, is likely to be marked by a continued fusion of human and machine intelligence, leading to unprecedented methodologies and applications. This evolution will continue to challenge tradi-

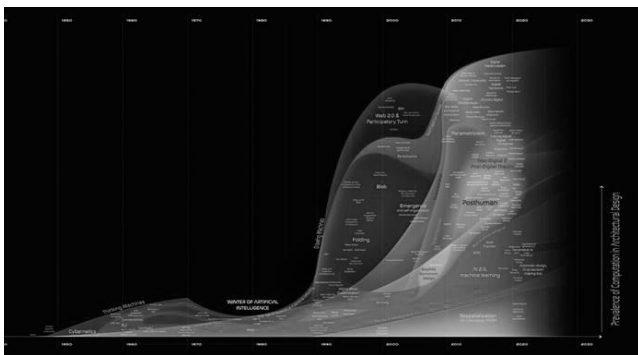


Figure 1: Mark Garcia and Steven Hutt, "Prevalence of Computation in Architectural Design," 2023.

tional architectural paradigms, as AI becomes an integral part of the architectural discourse, reshaping design methodologies and the built environment itself. Kuhn elucidated how the accumulation of anomalies within a prevailing scientific framework precipitates a crisis, ultimately leading to a paradigm shift that redefines foundational principles and methodologies (Kuhn, 1962, pp. 92-110). Analogously, as AI becomes an indispensable component of architectural discourse, it disrupts conventional design methodologies and the conceptualization of the built environment, heralding a paradigmatic transformation. This shift is not merely technological but philosophical, challenging architects to reconceptualize the role of the designer in the digital age and the means through which architectural solutions are generated and realized. Reflecting on the initial outcomes of digital generative design experiments at Columbia University, Greg Lynn observed a notable uniformity in the results. As cited in Cramer and Guiney (2000), Lynn remarked, "They all looked the same. It's the technology. We were figuring out the limitations of the software. It happened in every other industry: for a while all cars looked like Taurus. It'd be naïve to think it wouldn't happen in architecture." This comment underscores Lynn's perception that the homogeneity in design was a consequence of the architects' nascent familiarity with the technology, a phenomenon not unique to architecture but observed in various industries during the adoption of new technologies. This being said, the power of generative AI, more specifically through generations by prompting, does not solicitate an unparenting from what Lynn stated, rather than a rethinking of its powerful capabilities; opening up a new world for experimentation through literal expression and abstraction that surpass traditional algorithmic limitations. Perhaps, the need to address a new continuum emerges.

Deciphering the 'Computational Continuum': A new epoch in architectural design.

The advent of the 'Artificial Epoch' in architectural design marks a significant transformation in the discipline, characterized by the interpretation and application of Artificial Intelligence (AI); rising an emergence for a 'computational continuum' definition. With computational continuum we shall understand an ever-evolving framework where computational design methodologies are continuously reshaped by the integration and metamorphosis of AI, leading to unprecedented as well as speculative architectural designs and solutions. Theoretical foundations can be traced to the works of pioneers who foresaw the impact of technology on architecture. For instance, Kostas Terzidis in "Algorithmic Architecture" (Terzidis, 2006, pp. 45-60) explores the possibilities of algorithms in shaping architectural form and function. Furthermore, Generative Design (GeD) methodologies find their conceptual underpinning in the work of Mitchell's "Computer-Aided Architectural Design" (Mitchell, 1977, pp. 89-102), which lays foundations for understanding the potential of computational techniques in architectural design. Moreover, finished constructions like Zaha Hadid

Architects' Morpheus Hotel in Macau exemplify the innovative application of algorithmic design techniques, leveraging AI to generate intricate, fluid structures that redefine architectural aesthetics and functionality, demonstrating the capacity of AI to conceptualize forms that were previously unattainable (Zaha Hadid Architects, 2018, pp. 24-30).

The EDGE Olympic building in Amsterdam, designed by PLP Architecture, utilizes AI to enhance environmental sustainability, illustrating how AI-driven solutions can address critical ecological issues by optimizing building performance and energy efficiency (PLP Architecture, 2019, pp. 15-20). The significance of Generative Design (GeD) lies in its ability to synthesize vast amounts of data, environmental factors, and user preferences, resulting in designs that are not only innovative but also contextually and functionally appropriate. This approach redefines the architect's role from a sole creator to a curator of possibilities, where the final design is a product of a collaborative process between human expertise and computational intelligence. The integration of generative design in architectural practice signifies a shift towards an era where design solutions are not static but are constantly evolving, mirroring the dynamic nature of the environments they inhabit. AI at the other hand, can enhance these processes by providing constant feedback through supervised/unsupervised learning experiences throughout trainings of datasets, resulting in an "artificial brain" which thinks and makes decisions. Nowadays, the power of AI iterative technologies leads to user-friendly high-end products that can be generated by crafting a single prompt and clicking 'enter'. And this is only the beginning...

Even though Generative Design and AI are only parts of the large computational techniques used by industry and researchers nowadays, they stand out as two large umbrellas of computational practices; which subsequently keep specializing as technology advances, by forging new sub-terms and methodologies. Despite the clear differences in their 'built-in' architecture as well as performance, their behavior in working and usage, do have some similarities which will be examined later on this paper. Due to these similarities, is crucial to articulate and refer to a continuum rather than two different umbrellas that exist inside of the big computational framework regarding the AEC industry. This being said, today's role of AI in this continuum is not limited to a mere tool or extension for efficiency, but extends to being a collaborative partner that enhances the creative process. This shift is significant as it moves beyond the conventional boundaries of architectural design, incorporating data-driven algorithms and machine learning techniques in crafting spaces that go beyond our physical understanding of space. The computational continuum builds upon these concepts, contextualized in the "AI-epoch"; presenting a methodology that integrates human intuition with algorithmic precision, creating a symbiotic relationship between architect and AI. This approach aligns with the speculative nature of contemporary architectural practice, where design is an exploration of possibilities rather than a predetermined outcome.

Shout-out to Pioneering!

Initially hailing from avant-garde top-leading bastions such as the UK, Germany, Denmark, Spain, or even Canada, generative design methodologies nowadays cascade through academic corridors, birthing a specialized sub-profession — the "Computational Design Specialist." In the current discourse, algorithms, and more pervasively the integration of artificial intelligence (AI), intertwine seamlessly within architectural design and methodologies. This exposé explores the role of Generative Networks, entwined with AI, as they weave the fabric of design options. A discordant symphony emerges, challenging preconceptions of their "artificial" essence. A burgeoning commercial sub-profession emerges, beckoning contemplation on the dual specters of peril and promise to accompany AI's integration into architectural design. Can we, hand-in-hand, enfold these technologies to inaugurate an epoch of architectural unlimited supremacy? The query begets no facile response, for its essence resonates within the intricate dance of technological progression and the enigmatic pulse of societal awareness. In this arena, where the quantized cognizance of today's multi-layered social stakeholders plays an unprecedented role, the trajectory of AI integration into architecture crystallizes even more. This is an inevitable process that accompanies technological progress, but the shape of the crystal, is yet to be determined. Venturing beyond rhetoric, I have been in a constant experimentation process with AI iterations on venerable generative platforms and servers like Midjourney, DALL-E, LookX AI, etc., proffering a narrative etched in firsthand encounters. An intriguing dichotomy unfolds — critics decry the capricious ultra-realism of AI-generated images, perceiving an ominous threat to the traditional renderer's mastery. Simultaneously, advocates extol the incomparable quality of AI-crafted imagery, illuminating the depths of design cognition that often is eclipsed by the client mind's recesses. Within its pages lie revelations of potential pitfalls and shadows cast by the weight of prejudices and judgments. An impassioned plea reverberates — a plea for a comprehensive theory for pinpointing the authentic needs and boundless opportunities that AI consigns upon the future contours of computational architecture.

In this context of evolving paradigms and polarized perspectives, the critical discourse surrounding the integration of Artificial Intelligence (AI) in architectural design becomes ever more salient. Detractors, express apprehensions regarding AI's potential to diminish the role of traditional craftsmanship and intuition in the architectural process, fearing a loss of the human touch that underpins architectural creativity (Johnson, 2020, pp. 75-80). Conversely, proponents advocate for the unparalleled precision and innovation that AI introduces, arguing that it augments rather than replaces human ingenuity, offering new avenues for exploring architectural forms and functions (Smith, 2019, pp. 142-145). This debate is framed within a broader inquiry into how AI can be harnessed to serve not just as a tool for efficiency but as a collaborator in the creative process, seeking a synthesis where technology enhances the architect's vision and responsiveness to complex design chal-

lenges (Doe, 2021, pp. 60-65). The crux of this discourse lies in the development of a nuanced understanding of AI's role in architecture — one that recognizes both its limitations and its potential to redefine the boundaries of architectural imagination and practice (Brown, 2022, pp. 33-37). This ongoing dialogue underscores the necessity for a balanced approach to AI in architecture, one that cultivates a symbiotic relationship between technological advancements and the timeless principles of architectural design.

The pioneering work of Matias Del Campo and Daniel Bolojan, has been instrumental in advancing this discourse, demonstrating the profound impact of AI on creativity, optimization, and sustainability within the architectural domain. Del Campo's explorations into generative design processes facilitated by AI have underscored the potential for machine learning algorithms to produce innovative architectural forms, thereby expanding the aesthetic and functional possibilities available to practitioners. (Del Campo, 2022). Similarly, Bolojan's research into non-standard and computational design strategies has illuminated the augmentative capacity of AI in enhancing human creativity and efficiency (Bolojan, 2022). By investigating the intersections between AI, computational design, and digital fabrication, Bolojan has contributed to a deeper understanding of how these technologies can be harmoniously integrated into architectural practice to foster innovative solutions and methodologies. Today, people all around the world are aspiring to open some of the first AI-powered architectural design studios, inspired by the knowledge and devotion of Tim Fu (ex-ZHA), who legitimately claims that has now opened and runs the first AI-powered architectural studio in the world. Can you think of the role of an architect in your country, region or even continent? Is this profession demanding more specialized workers or are they searching for the old “do-it-all” architect which meets the client, draws the plans, makes the 3D, renders, presentations and even collects the salaries at the nearest branch? Because, dear reader, we need to embrace the complex reality of our profession and break down tasks in more numerous but easier ones (Alexander, 1965). And to do this, we need more people, more funds and more importantly, more time! In an epoch where all odds are against human repetitive tasks due to mental consumption and increased psychological problems leading the way, investigating smart and efficient AI integrated methodologies might be the only way out, to push further steps toward, rather than backward!

By not entering in depth the philosophical discourse of time perception regarding our comprehension of “present state” as an abstract concept for time understanding rather than an ever-present spatio-temporal continuum, we shall all agree that the future is here and the future is now! The future is for those who are ready to embrace technologies and adapt to this exponential growing, quick-paced reality, embracing and addressing all the emerging concerns. Nobody believed that the world wide web would influence humanity at the scale that it did when it first released to public; and nobody believed that AI technologies will impact the way we think, work and behave in our daily

basis; but here we are, reading, writing and researching about it so much, because its crucial to understand its ever-changing dynamics, in way to achieve a fruitful, not-so-harmful, ever-efficient and ever-adaptive innovative usage; responding to our contextualized professional daily needs!

Quantized, Quantum, Qauntuum...

Navigating the non-normative terrain of this research complicates the selection of a suitable language, encapsulating the uncertainty enveloping the forthcoming years. The research is, at its core, an experiment, a pursuit of audacious ambitions in a world where innovation has evolved into a dynamic entity of its own. As we navigate this unexplored territory, the evolving relationship between architecture and AI is akin to a student surpassing its master. But to build up a clear vision of AI potential and its application to architectural design processes, I would like to start from a simpler version of generative logic that leads the way to a fully comprehensive potential: the above-mentioned Generative Design (GeD).

Remembering the moment when I was firstly introduced to GeD in its algorithmic context, mr. Marco Mondello, my professor of CAD Logics at the Anhalt University of Applied Sciences at that time, stated the clear differences between the actual physical space and the design space used in fueling up generative scripts. The well-known acronym (DSC), refers to the “Design Space Construction” and goes beyond our understanding of a mere physical space-time continuum, forging a strong and clear concept for a “non-physical space for data exploration”, following up a purely holistic approach. To make it easier to understand, think of the DSC as an ideal infinite space of alternated options/scenarios which can take life in infinite contexts. Imagine a random/amorphous 3D model where you can choose where to perform 2D section-cuts; and now think of the infinite possibilities of physically performing it by constructing a possibly infinite number of planes that cut the model through 3 points of all possibly different coordinates:

Possible section cut [A-A'] – Plane constructed between points A - (x1;y1;z1); B - (x2;y2;z2); C - (x3;y3;z3)

Possible section cut [A-A'] – Plane constructed between points A - (x1;y1;z2); B - (x2;y2;z2); C - (x3;y3;z3)

Possible section cut [A-A'] – Plane constructed between points A - (xn;yn;zn); B - (xm;ym;zm); C - (xi;yi;zi)

Possible section cut [A-A'] – Plane constructed between points ...

Possible section cut [B-B'] – Plane constructed between points A - (x1;y1;z2); B - (x2;y2;z1); C - (x3;y3;z1)

Possible section cut [B-B'] – Plane constructed between points A - (x1;y2;z1); B - (x2;y2;z1); C - (x3;y1;z3)

Possible section cut [B-B'] – Plane constructed between points A - (xn;yn;zm); B - (xm;ym;zn); C - (xi;yi;zi)

Possible section cut [B-B'] – Plane constructed between points ...

Possible section cut [C-C'] – Plane constructed between points ...

The holistic approach translates possible data interconnections in perceivable generated scenarios through text, geometries or even images. But if we go a little bit deeper in the analysis, DSC is established by domains and as a consequence, is also restricted by them. The word “restriction” is generally conceived as a negative influence that limits possibilities; but in this case, it might be the most important and crucial element that helps the user to adequately know what and how to search for. In an era where Skender Luarasi, Ph.D., and other eminent scholars interrogate the terminus of design processes, an equally pivotal inquiry emerges regarding their inception, particularly in a landscape where technological advancements enable the rapid generation of design outcomes from mere prompts (Luarasi., 2022). This juxtaposition of beginning and conclusion within architectural design processes embodies a continuous dialectic experienced by practitioners, shaped profoundly by their educational and professional trajectories. The exploration of this dialectic reveals a nuanced understanding of design as a cycle, where the initiation and cessation of processes are intrinsically linked, thus challenging architects to reconsider the foundational strategies that underpin their work. Today's discourse seeks to elucidate design strategies that harmonize with the concept of Design Space Construction (DSC) amidst the iterative evolutions propelled by Artificial Intelligence (AI).

The complexity of this endeavor mirrors the intricate nature of contemporary data landscapes, exponentially expanding in a manner that defies traditional processing capabilities. This expansion can be likened to a quantum state, where the precise definition eludes due to the observer's incapacity to simultaneously comprehend all phenomena, leading to an ambiguous superposition of translated geometries. Such geometries, existing beyond the confines of clear Cartesian boundaries, evoke the necessity of reimagining design spaces as fluid constructs, adaptable and responsive to the ever-changing inputs provided by both human insight and algorithmic calculations. This paradigm shift underscores the importance of a holistic approach to architectural design, where the binary between beginning and end is dissolved in favor of a continuous, iterative exploration of possibilities. In this context, the role of AI becomes not merely generative but deeply integrative, facilitating a symbiotic relationship between technological potential and architectural creativity, powered by human intuition. Thus, the challenge and opportunity lie in conceptualizing design processes that are both reflective and forward-thinking, capable of navigating the ambiguous terrain between inception and conclusion. By adopting a quantum-inspired perspective on design, architects and researchers can foster a more dynamic and adaptable methodology, one that embraces the complexities of modern technological advancements while remaining attuned to the fundamental human elements of space and place.

"Artificial" Domains

Neural networks and noise maps are essential performative components which power AI-image generative algorithms, and as a consequence necessitate a nuanced understanding of

their combined capabilities and limitations. A neural network represents an artificial intelligence methodology that enables computers to emulate data processing mechanisms akin to the human brain. This approach, part of a broader category known as deep learning, employs a network of interconnected nodes or neurons arranged in a hierarchical structure, mirroring the brain's architecture. (Goodfellow, Bengio, & Courville, 2016). By simulating the complex processing of biological neurons, NN offer a robust framework for learning and replicating intricate patterns, essential for guaranteeing senseful and coherent *brain-like* iterations. At the other hand, within machine learning, "noise" denotes random or unpredictable data variations that hinder the identification of clear patterns or relationships within these iterative models. This interference can significantly reduce a model's prediction accuracy or the reliability of its outcomes, posing challenges in data analysis and interpretation. Contributing more to texture and variability, they are essential for providing realistic visual simulations, yet their application must be meticulously calibrated to avoid overwhelming the design with randomness, thus undermining the architectural intent. (Perlin, 1985) The synthesis of these technologies into AI image generators requires a delicate balance, ensuring that the output not only embodies innovative design principles but also adheres to functional requirements and aesthetic considerations. This complexity underscores the need for advanced algorithms capable of guiding the AI's generative process, steering it towards outcomes that are both innovative and applicable within the architectural domain. Until the full AI-automatization of the process, that will still lack of original human guidance, we can start addressing the problem of stopping by considering solving the problem of starting, through intuitively predicting final results based on constraining input datasets. Zooming out, considering the affiliation in the above defined computational continuum, we can search for similar applicable methodologies in the continuum, to control the spectrum of research through AI generations. Looking back to computational design methodologies, these datasets can *be variably-controlled* through *domains*. The evolution of AI in architecture thus depends on overcoming these analytical and computational challenges which consider intuition as a collaborative approach, paving the way for a future where AI-assisted design processes produce results that are as practical as they are visionary. In order to do so, we need to address the need for better control.

When firstly introducing domains in computational design to my architecture students, I usually refer to them as “setting limits” for being able to control infinite iterative processes enter a desired “rule of order”. But in the case of explorative AI generated images, this definition of domains does not represent the full meaning to my understanding of them. Domains in AI generative images through prompts might not even be a thing either; but it is crucial, for the way this exploration goes on, to keep an open eye on the essence of this concept! When talking inputs, in the now “traditional” computational design framework, we usually refer to (but not only): variables - which translate in numbers, Booleans - which refer to states like “true” or

“false” and sometimes, we refer to strings. All of them, for how much you might romanticize sciences and a programming language, lack of an important element that gives meaning to the essence of romance itself: linguistic expression! What I always found astonishing in AI generations is a deeper connection to the tool, if we shall call it like that. Rather than the tool, it might even be a more profound connection to ourselves. How? It often happened to me, but to many other professionals as I presume, that you have a great idea, a great concept, a great ambition to see the project go to the final design phase and visualization, but somehow, you sabotage this passion for the concept during the process itself; ending up with another extraordinary proposal of course, but at what costs? How can we evaluate 2 design proposals at once, if one of them was slowly suffocated to give birth to the other? Well, no longer! Even though to many of you the idea of romance between an AI and that guy in that famous movie might pop-up right now; I wouldn't go there, just yet! What I'm trying to articulate is that for as utopic or dystopic this might sound, it is possible to create a relation with the machine as much as it can trigger your emotions, beyond the mere “light-up the bulb” trigger of traditional/computational design processes. If done right, - and I don't think it would be sane to even try and write down a right or wrong thing about the topic yet, - but if done right; it can support, power and catapult different stages of design processes into new extraordinary dimensions.

Artificial Intelligence, but why 'Artificial' ?!

The advent of the so-called 'Artificial Epoch' in architectural design, marked by the integration of Artificial Intelligence (AI), can be debated not as a novel divergence but as a historical continuity. AI, in its capability to compute multi-layered data, does not simulate artificiality in design but extends the complexity and depth that traditional processes sought to achieve. This computational depth aligns with Rossi's notion of the city as a locus of collective memory, where layers of history, usage, and time coalesce ("The Architecture of the City," Rossi, 1982, pp. 130-131). AI's integration performs a similar synthesis, albeit on a dataset instead of a cityscape.

First of all, let's give credits to the adequate term of “prompt crafting” rather than “sentence writing”, because the main essence of crafting is preserved in its origins of hand-making or making something with your hands that go beyond the physical operation of hand. When you make something with your own hands, there are many hidden processes that the human mind evokes that we might be or not be aware of. How do I start? What do I predict to achieve? How much of this is really achievable? How do I do it? What if I fail? How much time does this take? How do I integrate my originality in this? Further dissecting the term 'artificial' within this context exposes its fallacy. The vast computing potential of AI stands not outside but within the continuum of architectural tools that have always sought to translate the multiplicity of human experience into built form. This is not dissimilarity but an evolution in methodology, resonant with the complex narratives that Koolhaas explores through the 'Exodus' or the 'Voluntary Prisoners of Architecture' (Koolhaas,

1972, pp. 18-34), wherein the depth of human intention and urban theory is woven into a speculative reality. The 'false facts' of AI — the initial apprehensions and misunderstood potential — are analogous to the early misconceptions of concrete in architectural applications, initially dismissed before becoming a staple of modern construction. These false facts, when engaged critically, propel our understanding forward, much like the Socratic method of elenchus, which advances knowledge through refuted hypotheses (Plato, "Phaedo," 2000, p. 89). Speculation, rooted in the richness of philosophical inquiry, emerges as the purest form of ideology for advancement and innovation. It is through the lens of speculative thought that AI in architecture is understood not as a mere tool but as an intellectual partner, expanding the horizons of the conceivable.

In this light, the role of AI in architectural design processes emerges as an authentic continuation of the architect's quest to materialize the complex spectrum of human experience. The 'Artificial Epoch' becomes a misnomer, as the integration of AI represents not a replacement but a refinement and expansion of traditional processes, inviting us to redefine what we consider 'natural' in the evolution of architectural methodologies. From now on, this research will investigate speculative methodologies in iterative design scenarios, which integrate a wholesome, yet not-so-automated, generative AI into architectural design.

Embracing "The Artificial" - the resurgence of speculative-ly contextualized architectural ornaments in the digital age.

The historical trajectory of architectural embellishments, particularly columns, orders, and ornamentations, reveal a nuanced narrative of decline post-World War II. The impact of war, coupled with the ascendance of modernist ideals, led to the marginalization of these once-revered elements. This exploration posits that the intersection of historical analysis and digital innovation presents a unique opportunity for the reinvigoration of architectural ornaments, transcending the limitations imposed by the tumultuous mid-20th century. The aftermath of the two world wars witnessed a paradigm shift in architectural ethos. Ornamentation, once celebrated for its ability to articulate cultural narratives, fell victim to the minimalist tendencies that emerged in the mid-20th century. This departure from embellishment was a response to the stark realities of the time, as architects sought simplicity and functionality in the face of widespread destruction.

The post-modernist movement, emerging in the latter half of the 20th century, aimed to revive architectural ornamentation. However, it faltered in its attempt, drowned in a cacophony of eclectic styles and disjointed references. The 'less is more' mantra, popularized by modernist architects, persisted, rendering post-modernist attempts at revival as chaotic and lacking in coherence. Notably, the influence of "Learning from Las Vegas" by Venturi is acknowledged, though its approach is considered insufficient for a genuine revival (Venturi, 1972). Fast-forward to 2024, where the digital age has ushered in transformative possibilities for architectural design. In this era of computational prowess, the re-incorporation of architectural ornaments

emerges as a compelling proposition. The digital tools at our disposal not only facilitate the resurrection of classical embellishments but also provide a platform for their reimagining in ways unimaginable in previous epochs. This posits an anti-thesis to the modernist dictum of 'less is more,' asserting that in the current socio-cultural context, 'more is more.' In an age where digital advancements allow for intricate detailing and mass customization, the need for architectural artifacts and richness becomes pronounced. The research provocatively challenges the prevailing minimalist trends, advocating for a return to a visual language that embraces the complexities and nuances of human experiences, as described by the quantum state.

(1) Methodological Application-simplified case study:

Proposed Methodology overview (a):

The first methodology that I am going to present, fuses generated AI imagery (through Midjourney v5.2) with the spatial interpretation capabilities of the Monolith (by Andy Pane) plugin for Grasshopper & Rhinoceros 6/7 (McNeel & Associates), denoting a significant leap in architectural design processes. This approach reflects a computational alchemy, whereby the AI's abstracted representations become the raw materials for three-dimensional, constructible forms. In the tradition of Eisenman's explorations of the interplay between diagram and architectural space (Eisenman, 1999), this methodology harnesses AI to generate initial images that embody not only form but also the latent potential for spatial complexity. These images, once translated by Monolith, echo the sentiments of Tschumi's disjunctions, where form is liberated from function to embrace a multitude of interpretations (Tschumi, 1994). The resultant 3D models are not static endpoints but are iterative steps in a continuous design evolution, where the transition from 2D to 3D and beyond becomes a reflective dialogue between emergent technology and established architectural thought.

The rendering and visualization of these models in various styles present an opportunity to speculate on new ornamental paradigms within the 'Artificial Epoch.' This speculative approach is reminiscent of the work of Venturi, who celebrated the complex and contradictory as a means to richer architectural expression (Venturi, 1966). As these models are rendered, they embody the multiplicities of their genesis—each style offering a different narrative of the form's potential, from the serene to the sublime. This generative process does not merely suggest new aesthetic directions but rather proposes a paradigm shift in architectural genesis. It calls for an open discourse on further research, emphasizing the potential of this methodology to recalibrate our theoretical and practical understanding of architecture. The game-changing potential lies in the capacity for continuous reinterpretation and reconfiguration—a fluid architectural language for the digital era, echoing the adaptable systems envisioned by Frazer (Frazer, 1995). The investigation of such methodologies point to a future where architectural form is not only responsive to but anticipatory of its environmental and social context, paving the way for an architecture that is as dynamic and ever-changing as the society it serves. This line of inquiry

posits a fertile ground for academia and practice alike, signaling a renaissance of architectural exploration in the digital age.

(1) Proposed methodology hands-on (b):

Supervised Generative AI prompts through pseudo predictable speculative DSC (1) → Generating input images via AI Platform (2) → Computational Blend through 3D translation (3) → Further AI contextualization (4) → Computational Fabrication (5).

STEP 1 - Supervised Generation of AI prompts through pseudo predictable speculative DSC (1)

1-A) – Building up a 'mental domain' continuum (similar to a mental map), merging up abstract notions of our understanding (ex. "the quantum state") - to achieve a speculative and unprecedented result, - with very simple concepts (ex. "columns").

1-B) – Making use of AI text platforms like "ChatGPT" (or similar) to generate adequate prompt iterations, optimized for the desired AI platform that we are going to use for generating the input images (Midjourney v5.2) that resonate: ex. "your comprehension of columns in a quantum state"

1-C) – Keeping in mind that we will use an image to 3D translator like Monolith Plug-in for Grasshopper (Rhinoceros 6/7), also considering the process of pixel translation from color to numbers, it would be better to generate monochrome pictures in way to help the software achieve a more rationally comprehensive form. Moreover, Monolith plug-in natively generates a 3D model from 3 axes blending of input images, X/Y/Z, so we will need to give as inputs a minimum of 3 images; one per each axis.

1-D) – Ask AI platforms like "ChatGPT" (or similar) to: "Help me generate 3 adequate prompt iterations, one per each view: top, right and left, monochrome with white background, optimized for Midjourney v5.2, that better visualize your comprehension of columns in a quantum state"

1-E) – Check, control and use desired prompts, if they make sense to you and represent the essential meaning of what you wanted to craft. Add desired resolution at the end of each prompt. Example of an interesting output evaluated by pure human **intuition (by author):**

Top View Prompt: Imagine a top-down view of an array of slender, ethereal columns, each representing a quantum state in a serene, monochrome landscape. These columns, set against a stark white background, are interlinked by delicate, web-like structures symbolizing quantum entanglement. The air around each column vibrates with a subtle shimmer, hinting at the superposition principle, where each column exists in multiple states at once. This scene is captured in high contrast monochrome, emphasizing the interplay of light and shadow to depict the unseen forces and the probabilistic nature of quantum mechanics. –ar 1:1 –v 5.2

Right Side View Prompt: Visualize from the right side, a series of abstract, monochrome columns standing against a pure white backdrop, each column gracefully ascending and intricately detailed to represent a quantum state. From this perspective, the columns are interconnected by thin, almost invisible lines, suggesting the complex relationships and entanglement between quantum states. The texture of the columns suggests

a dynamic, fluctuating surface, capturing the essence of quantum uncertainty and the wave-particle duality, all rendered in a minimalist black and white palette to focus on the form and structure of quantum interactions. –ar 1:5 –v 5.2

Left Side View Prompt: From the left side, picture a collection of tall, spectral columns in monochrome, each uniquely shaped to symbolize different quantum states, against a clean, white background. These columns are connected by a network of faint, swirling patterns, representing the fluid, interconnected nature of quantum mechanics. The play of light across the columns reveals a world of probabilities and possibilities, with shadows and highlights designed to suggest the movement and energy of particles at a quantum level. The scene is a study in contrast and subtlety, showcasing the elegance and mystery of quantum states in a stark, monochromatic scheme. –ar 1:5 –v 5.2

STEP 2 - Generating input images via AI Platforms

2-A) Accessing AI generative servers like Midjourney (DALL-E, Stable Diffusion, etc.) to generate finite iterations for each prompt. The process of stopping the iterations or selecting the best generation can turn out to be extremely difficult and unprecedented, but this will be food for thought to other researches, as it is not a mere intent of this paper. We will just stop wherever we think it's the best option, as well as we will try different iterations on Grasshopper and see different results.

2-B) Selecting and upscaling desired input images, while documenting each iteration with specific codes like numbers or letters in our electronic device (PC/Mobile); to better comprehend the progressiveness of the quality for each generation. You can see some of the upscaled variations of top view generated images on Figures 2,3 and 4 while the side views' iterations are shown in Figure 5.

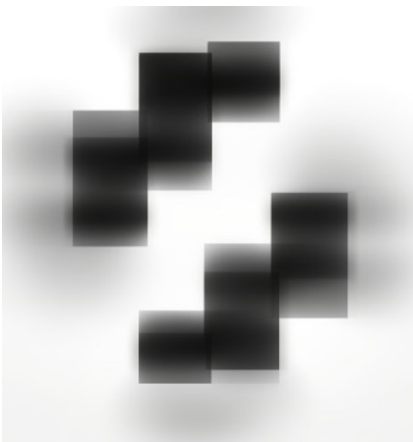


Figure 2: by author, Upscale 4 – Variation 1

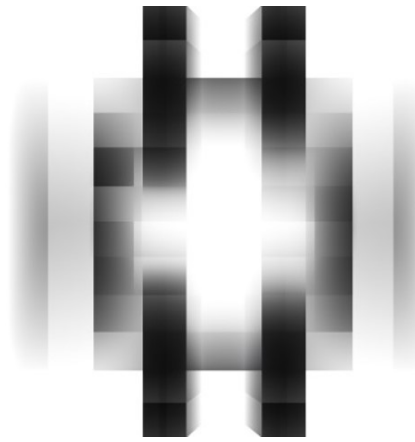


Figure 3: by author, Upscale 2 – Variation 2

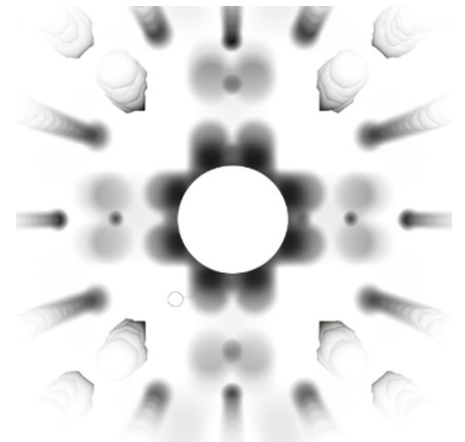


Figure 4: by author, Upscale 3 - Variation 3

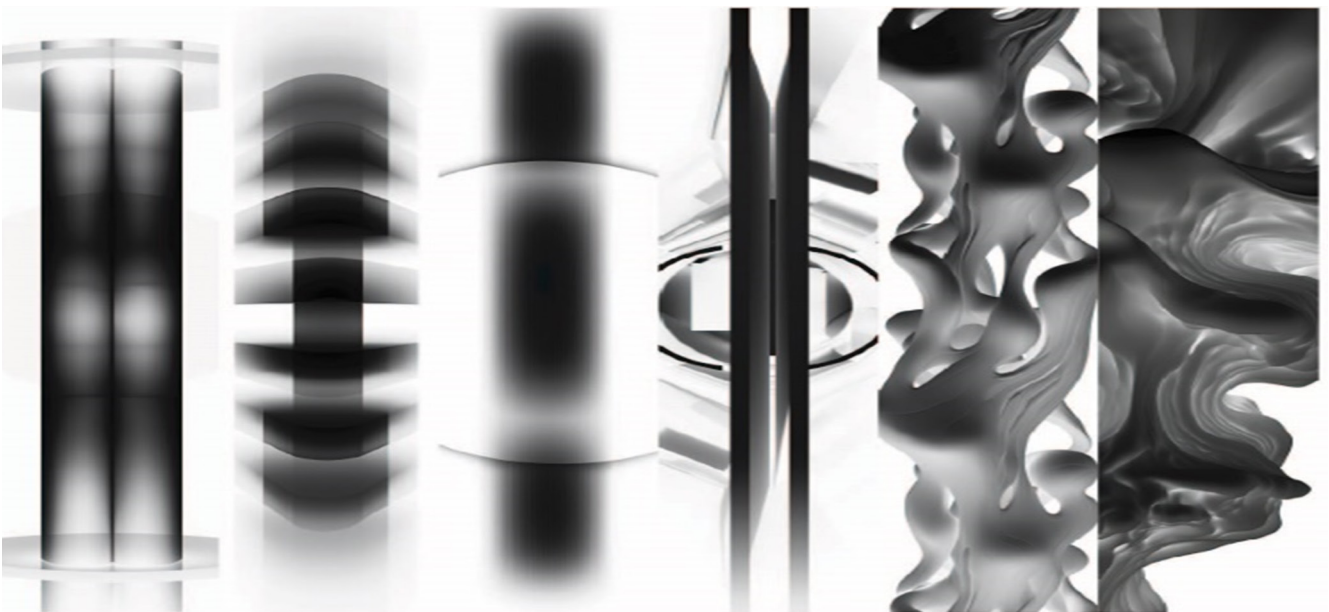


Figure 5: by author, Upscaled Variations - Side Views (Right & Left)

STEP 3 - Computational Blend – Images to 3D translation through 3 Axes (X/Y/Z)

3-A) – Assuring the right installation of Monolith Plug-in (by Andy Pane) for Grasshopper in Rhinoceros 6/7. Insertion of input images in 3 Axes to generate the 3D mesh.

3-B) – Generating variations by replacing the input images with other input variations taken from Step 2.

3-C) – After choosing one/couple 3D meshes, we bake the geometries from GH into Rhinoceros (V1 – Figure 6).

3-D) – Play around in traditional CAD Modelling in Rhino, by applying different scales, sizes, ratios etc. (V5/6/7 - Figure 7) and export best images in High Resolution JPG/JPEG/PNG (or similar).

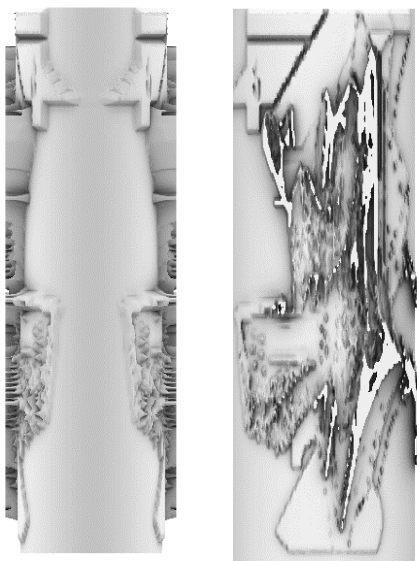


Figure 6: - by author, Algorithmically Generated via Monolith in GH - Side Views (Right & Left) v1

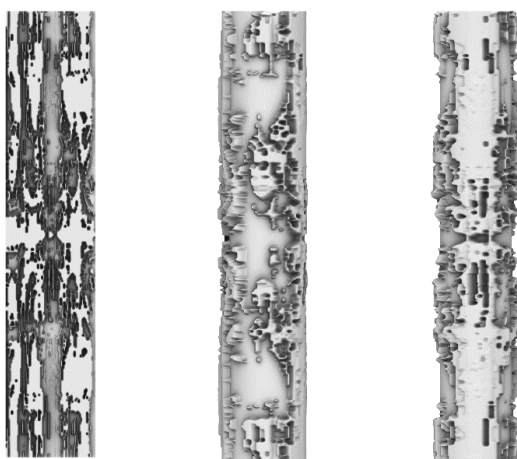


Figure 7: by author, Algorithmically Generated via Monolith in GH - Side Views (Right & Left) v5/6/7

STEP 4 – Further AI contextualization

4-A) – Upload High-Resolution images to the world wide web by getting an accessible image link via public servers/domains or similar (ex.: <https://postimages.org/>).

4-B) – Insert link in AI servers like Midjourney (or similar) and set a low style of abstraction (ex. $-q < 50$, or similar; depending on the platform you are using), while crafting your prompt of reference and generating variations. (Figure 8)

4-C) – If you are not satisfied with the results, try going back to AI text generations to better optimize your prompt with your desired output specifications. Example: “Read and comprehend the following prompt, and craft me the best prompt possible to achieve the essence of it: digital neo-gothic hyper-realistic column with high-end quantum detailing that represent the complexity of today’s architectural paradigms’ shift”.

4-D) – Example of a final prompt iteration generated and optimized for Midjourney version 5:

“<Link of image file, previously uploaded> Envision a column that embodies the fusion of past and future: a masterpiece of digital neo-gothic design, hyper-realistic in its execution, standing tall against a stark, minimalist background, preserving the essence of the initial input image provided through the link. This column is not just a structure but a statement, intricately detailed with motifs that draw from the rich heritage of gothic architecture, yet reimagined. Picture high-end, quantum-inspired detailing that weaves through the column's fabric, suggesting a mesh of otherworldly energy and matter; symbolizing the complex evolution of architectural paradigms. The column's texture is a juxtaposition of ancient stone and futuristic, shimmering quantum particles, creating a visual metaphor for the transition from traditional to contemporary architectural thought. The lighting is dynamic, highlighting the column's intricate details, casting shadows that dance and reflect the quantum detailing, enhancing the depth and dimensionality of the structure. This digital rendering should not only capture the viewer's gaze but also provoke thought on the seamless integration of historical elegance and cutting-edge innovation, representing the complexity and fluidity of today's architectural shifts. $-q 50 -ar 9:16 -v 5.2$ ”

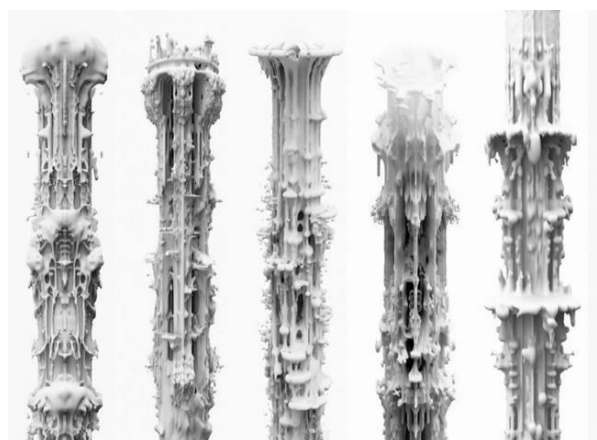


Figure 8: AI iterations of Contextualized Columns

STEP 5 – Computational Encoding & Fabrication

5-A) – Bearing in mind the possible encoding of the image through image to 3D algorithms, we need to assure an orthogonal qualitative image of the column.

5-B) – Through Grasshopper algorithmic assistance, it is possible to build simple scripts that mimic a simplified version of what Monolith does, reading every pixel as color by later translating each color code to numbers. The list of numbers can then be re-mapped in desired values in way to achieve a detailed 3D Mesh.

5-C) – In older versions like Rhino 5/6/7 there will be a need for assuring the closing of the mesh and guaranteeing a good and clear geometry, while in the latest Rhinoceros 8 (McNeel & Associates), a new command called ‘Shrink Wrap’ is available. It automatically adjusts and clears the mesh for 3D printing purposes. Once this process is concluded, we can also think of other fabrication methods like laser-cutting profiles (ex. through ‘Contour’ in X/Y/Z axis) (Figure 9), negative mold creation, etc.

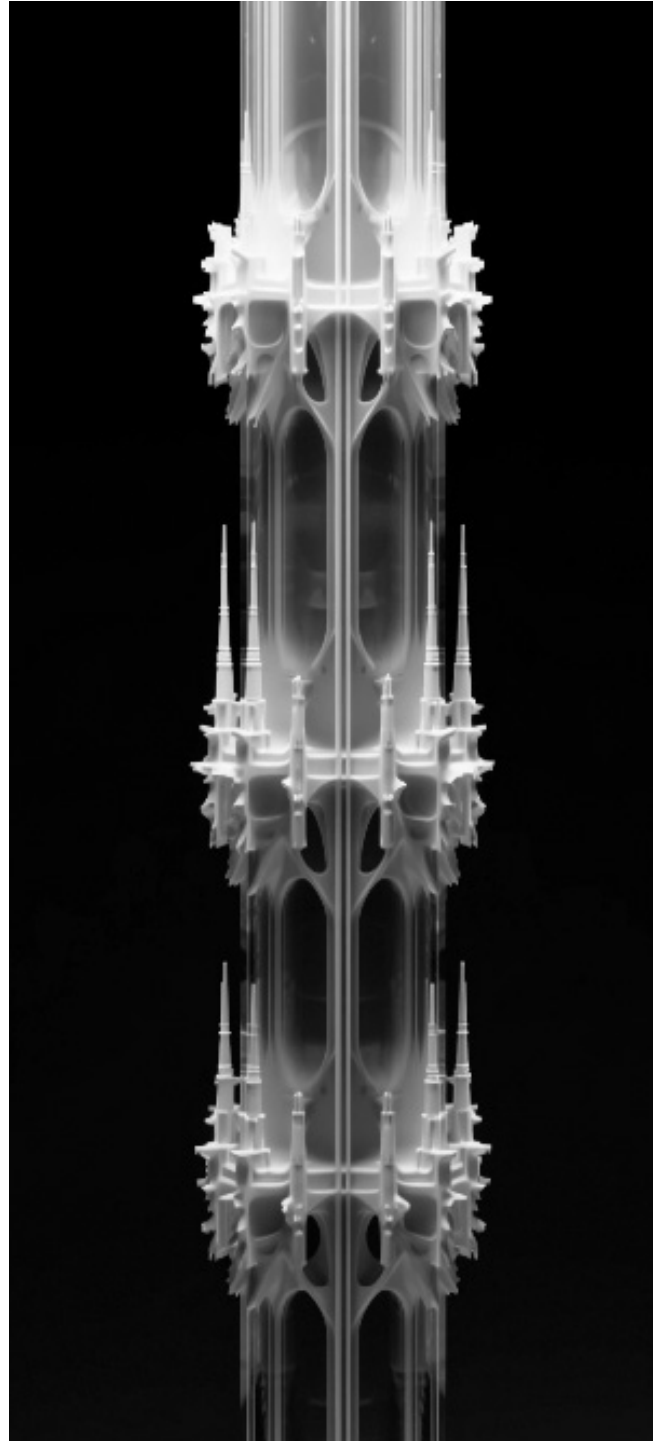


Figure 9: Fabrication Proposals of Columns’ Iterations, Generated through the Computational Continuum philosophy

Limitations and further developments

As we crest the current wave of the 'Artificial Epoch,' it is imperative to acknowledge the limitations inherent in the integration of AI within architectural design. The fidelity of AI-generated designs is bound by the quality and breadth of input data; richness in, richness out. The computational continuum we navigate is not free from the constraints of existing technologies and the current state of machine learning and cognitive computing. These tools, while revolutionary, are not panaceas. They function within the bounds of our current understanding and capabilities, leaving ample room for further development.

The expansion of AI's role in architectural design predicates not only on technological advancements but also on our capacity to adapt our methodologies to its evolving nature. The role of AI must extend beyond a generative force into realms of critical analysis and decision-making. Further developments could see AI not only suggesting forms based on environmental data but also critiquing its own designs, engaging in a form of self-improvement and learning that mirrors the architect's own reflective practice.

The future beckons a multi-disciplinary approach, blending cognitive science, environmental psychology, and computational design to cultivate AI that understands context, culture, and the subtleties of human experience. Such advancements will challenge the boundaries between the natural and the constructed, the real and the simulated, ultimately leading to a more holistic, integrated approach to architectural design. Despite its clarity, the study faces limitations due to its speculative nature and the rapid pace of AI development, which may not capture the full spectrum of future advancements in architectural practices. The scope of this research is limited by the current technological landscape and the speculative application of AI in architecture. The evolving nature of AI tools and methodologies presents a challenge in predicting long-term effects on architectural design processes and outcomes. Future research should focus on empirical studies to assess the practical impacts of AI in architecture, from design to construction. Investigating the ethical, social, and cultural implications of AI in design practices is also crucial for ensuring that technological progress aligns with sustainable and human-centric values. Collaborative efforts between architects, technologists, and ethicists will be key to developing AI applications that are innovative and ethically responsible.

Conclusions

This inquiry into the 'Artificial Epoch' has revealed the profound entanglement of AI with the future of architectural design. Far from diminishing the role of the architect, AI augments the creative process, providing a new set of tools to navigate the complex, multivalent challenges of modern design. The speculative nature of architecture finds a kindred spirit in AI's predictive models and generative capabilities, offering a sandbox for innovation and experimentation. The AI-augmented design processes reflect an evolution, not a replacement, of traditional methodologies. They offer a bridge to new forms of architec-

tural expression and understanding, rooted deeply in the rich soil of history and philosophy, yet reaching out to the boundless possibilities of the future. There is an urgent need for speculating, addressing and consolidating different methodologies as well as their possible appliances which constantly adapt to the ever-evolving state of technological advancements. As we embrace this new era, it is important to underpin the AI integration as a possible partner in the creative process, a medium through which the architect can explore uncharted territories of design with newfound clarities and depth.

The 'Artificial Epoch,' then, is a misnomer for what is genuinely an age of augmentation and amplification of human potential through the lens of computational intelligence. It is an epoch that stands to redefine not just how we design but also fundamentally, what we conceive as architecture in the context of our ever-changing world. In the exploration of the symbiosis between artificial intelligence (AI) and architectural design, this study has illuminated the profound implications of AI's integration into speculative design methodologies and the computational continuum. The evidence presented, suggest a pivotal shift towards an architecture that is both responsive and anticipatory, leveraging AI to navigate complexities and innovate sustainably. Looking forward, it is imperative that research continues to critically engage with the ethical, practical, and theoretical dimensions of AI's role in architecture. Such inquiry should aim to forecast emerging trends, delineate potential challenges, and propose frameworks that ensure technological advancements align with human-centric and environmental principles. This approach will not only refine our understanding of AI's impact but also guide the architectural discipline towards a future where technology and humanism are inextricably linked.

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Acronym	Full Meaning
AI	Artificial Intelligence
GeD	Generative Design
DSC	Design Space Construction
AEC	Architecture, Engineering & Construction
NN	Neural Networks